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AUTHOR Simmons, Herbert N.
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ABSTRACT

Intended to provide an alternative approach to learning situations or enhance existing programs, this docoument outlines an instructional unit about model rocketry. A philosophy statement is included which stresses the need for teaching about science-related social issues. Goals of the unit are stated for fine arts, mathematics, physical education, reading, natural science, and social sciences. The unit is divided into the three major areas of construction, launch, and experimentation, with proficiency requirements and an instructional sequence included for each. The "course guide" section contains descriptions of instructional activities and evaluation strategies, both of which are cross-referenced to specific proficiency requirements and the instructional sequence. Additional activities are provided in the appendix, along with a model rocketry safety code. Also included is a list of key vocabulary words used in the unit. (TW)

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COURSE GUIDE

MODEL ROCKETRY
in the
Elementary School
(grades 4-6)

by

Herbert N. Simmons, ED.D

Western Kentucky University

Bowling Green, Kentucky

Fall 1985

U.S. DEPARTMENT OF EDUCATION
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Herb Simmons received a Doctor of Education Degree in Curriculum and Instruction and School Administration from the University of Kansas in 1973. Between 1972 and 1975 he held the rank of Assistant Professor of Education at Northwest Missouri State University and in 1975 moved to Western Kentucky University where he now holds the rank of Professor and teaches elementary school science methods.

Professor Simmons has taught most grade levels from Kindergarten to grade eight but has spent most of his instructional time at the intermediate grade level. In 1966, Dr. Simmons was introduced to model rocketry through an Estes model rocketry workshop at the annual KATS Camp in Kansas. Since that time he has worked as a consultant and workshop director for Estes and several of his articles have been published in Estes Educator News.

COURSE DESCRIPTION

This unit of study is not intended to replace existing curricular materials nor is it intended to be utilized as the total curricular offering. It is intended to provide an alternative approach to learning situations and/or an extension or enrichment of the existing program. Model rocketry does provide an excellent opportunity to integrate learning in several curricular areas.

The best way to organize the unit is to classify the activities into three major areas - constructing, launching, and experimenting - as individual courses which may be taught as a continuing, tightly woven design or as individual courses which may be taught independently of one another.

Instead of breaking the program down into specific lesson plans, the major areas are presented as a continuous sequence. Individual teachers are provided the freedom to adapt the sequence to fit their instructional program and the needs of their students. Sample daily plans appear as Appendix A to this unit.

The best presentation of the materials in the unit will occur if the sequence is followed from the construction phase through the launch and then to experimentation. However, certain student groups may lack skills which will limit the sequence, or the student group may have skills which will allow the teacher to eliminate certain steps.

PHILOSOPHY

Students today will soon be operating as adults in a society which is even more technologically-oriented than at present; they will be participating as citizens in important science-related societal decisions.[1]

What science shall we teach for the year 2000? What knowledge and which skills will be necessary for survival? First, students must acquire an understanding of how science and math and development of a healthy and stable society impact one another. Second, students must acquire skills which will enable them to manipulate and interpret the data provided through science and math in ways which will enhance their own existence and the survival of society. Third, students must acquire a sturdy infrastructure of scientific concepts which will remain constant for many years.

All children are curious about their world and what is going on in that world. Very young children are interested only in their immediate environment, and older students normally expand their curiosity to a global or a galactic environment. Talking about these environments or experiencing visual reproductions captures their interest, but little true learning takes place until the student actually experiences the learning phenomena.

Model rocketry can provide opportunities for teaching understanding, skills, and knowledge in many areas of the curriculum. Model rocketry can be a tremendous motivator and will enflame students' curiosity and reinforce their cognitive skills. Real learning in a hands-on, do-it-yourself situation is virtally guaranteed to provide "lift-off" for many adventure-filled experiences.

Students will not master all the principles of rocketry through a unit involving model rockets, but they will become more interested in learning and in related societal issues. Best of all, they will be involved in learning through discovery.

[1]. Harms, Norris C., and Robert E. Yager. What Research Says To The Science Teacher: Volume 3. Washington, DC: NSTA 1981. p.129.

GOALS

FINE ARTS - The student may:

1. Gain confidence to express his/her own ideas.
2. Learn to control and utilize materials in various ways.
3. Produce an esthetically pleasing product.
4. Gain esthetic awareness.
5. Improve his/her own individuality, expressiveness, and inventiveness.

MATHEMATICS - The student may:

6. Improve skills in measurement and calculation.
7. Improve ability to collect, analyze, and apply statistics.
8. Improve understanding of geometric theory.
9. Improve problem solving skills.

PHYSICAL SKILLS - The student may:

10. Improve small muscle coordination and manipulation skills.
11. Improve skills and attitudes in competitive situations.

READING - The student may:

12. Extend his/her vocabulary to include aerospace terminology.
13. Improve skills involved in reading and following directions.
14. Identify main ideas and supportive details.
15. Summarize written and/or verbal directions and passages.
16. Recognize a stated sequence of events.
17. Screen a written passage or directions to obtain specific data.

NATURAL SCIENCE - The student may:

18. Improve the basic skills of observing, classifying, and communicating.
19. Improve his/her skills of collection of and organization of data.
20. Improve the skills of prediction, inference, and hypothesizing.
21. Identify and control variables.
22. Design and exercise experiments.
23. Gain understanding of the action/reaction theory.
24. Gain understanding of the gravitational theory.
25. Identify and describe the function of systems and sub-systems.
26. Analyze and synthesize simple problems.

SOCIAL SKILLS (SOCIAL SCIENCE) - The student may:

27. Develop interpersonal skills.
28. Rationalize the need for safety codes and regulations.
29. Improve self-image through successful completion of a reasonably complex task.
30. Develop some concept of personal management.
31. Develop some understanding of the impact of rocketry on society.

MODEL ROCKETRY

Subject Matter Outline

I. Introduction and Construction

A. Basic definitions and terminology
B. Reading and following directions
C. Basic construction skills

II. Launch

A. Launch procedure
B. Recovery procedures
C. Basic safety with model rockets
D. Tracking and recording procedures
E. Arming the rocket
F. Force, energy, and gravity

III. Experimentation

A. Basic design of experiments
B. Putting experimental design into action
C. Collecting and recording data
D. Conclusions and reporting

MODEL ROCKETRY

Proficiency Requirements

I. Introduction and Construction

The student may:

1-1 Extend his/her vocabulary to include aerospace terminology.
1-2 Improve skills involved in reading and following directions.
1-3 Identify main ideas and supportive details.
1-4 Recognize a stated sequence of events.
1-5 Screen a written passage or directions to obtain specific data.
1-6 Improve small muscle coordination and manipulation skills.
1-7 Gain confidence to express his/her own ideas.
1-8 Learn to control and utilize materials in various ways.
1-9 Produce an esthetically pleasing product.
1-10 Gain esthetic awareness.
1-11 Improve his/her own individuality, expressiveness, and inventiveness.
1-12 Improve self-image through successful completion of a reasonably complex task.

II. Launch

The student may:

2-1 Improve small muscle coordination and manipulation skills.
2-2 Extend his/her vocabulary to include aerospace terminology.
2-3 Improve skills involved in reading and following directions.
2-4 Summarize written and/or verbal directions and passages.
2-5 Recognize a stated sequence of events.
2-6 Screen a written passage or directions to obtain specific data.
2-7 Rationalize the need for safety codes and regulations.
2-8 Develop some concept of personal management.
2-9 Gain understanding of the action/reaction theory.
2-10 Gain understanding of the gravitational theory.
2-11 Identify and describe the function of systems and sub-systems.
2-12 Analyze and synthesize simple problems.
2-13 Develop interpersonal skills.
2-14 Improve self-image through successful completion of a reasonably complex task.

III. Experimentation

The student may:

3-1 Gain confidence to express his/her own ideas.
3-2 Learn to control and utilize materials in various ways.
3-3 Produce an esthetically pleasing product.
3-4 Gain esthetic awareness.
3-5 Improve his/her own individuality, expressiveness, and inventiveness.

3-6 Improve skills in measurement and calculation.
3-7 Improve ability to collect, analyze, and apply statistics.
3-8 Improve understanding of geometric theory.
3-9 Improve problem solving skills.
3-10 Improve small muscle coordination and manipulation skills.
3-11 Improve skills and attitudes in competitive situations.
3-12 Extend his/her vocabulary to include aerospace terminology.
3-13 Improve skills involved in reading and following directions.
3-14 Identify main ideas and supportive details.
3-15 Summarize written and/or verbal directions and passages.
3-16 Recognize a stated sequence of events.
3-17 Screen a written passage or directions to obtain specific data.
3-18 Improve the basic skills of observing, classifying, and communicating.
3-19 Improve his/her skills of collection of and organization of data.
3-20 Improve the skills of prediction, inference, and hypothesizing.
3-21 Identify and control variables.
3-22 Design and perform experiments.
3-23 Gain understanding of the action/reaction theory.
3-24 Gain understanding of the gravitational theory.
3-25 Identify and describe the function of systems and sub-systems.
3-26 Analyze and synthesize simple problems.
3-27 Develop interpersonal skills.
3-28 Rationalize the need for safety codes and regulations.
3-29 Improve self-image through successful completion of a reasonably complex task.
3-30 Develop some concept of personal management.
3-31 Develop some understanding of the impact of rocketry on society.

MODEL ROCKETRY

Instructional Sequence

I. Introduction and Construction

1-1 Component Parts
1-2 Use and application of construction materials
1-3 Systems and Subsystems
1-4 Model rocket decoration

II. Launch

2-1 Launch pad safety
2-2 Countdown procedure
2-3 Recovery procedure
2-4 Engine preparation
2-5 Prepping the model rocket
2-6 Parachute/streamer folding
2-7 Collecting data
2-8 Model rocket launch
2-9 Launch area clean-up

III. Experimentation

3-1 Definition of the problem
3-2 Related research
3-3 Experimental design
3-4 Action research and collection of data
3-5 Re-design, conclusions, and reporting

MODEL ROCKETRY

Vocabulary

I. Introduction and Construction

nose cone
screw eye
shock cord
body tube
launch lug
engine holder assembly
spacer rings
shroud lines
parachute
fins
leading edge
trailing edge
root edge
fillet
streamer
alignment

II. Launch

launch control officer
recovery team
safety control officer
ignition
lift-off
launch rod
blast deflector
launch controller
safety interlock
launch lug
countdown
apogee
thrust
acceleration
peak altitude
recovery system
ejection charge
micro-clips
stability
propellant charge
tracking charge
launch pad
electrical ignition system
sequence
countdown
touchdown

III. Experimentation

hypothesis
related literature
experimental design
data (datum)
conclusions
control
variable
experiment

MODEL ROCKETRY
Course Guide

Proficiency Code	Sequence	Instructional Activities	Evaluation
I. Introduction & Construction 1-0	1-A. Motivation	Short lecture with models, a demonstration launch, and/or the movie "Model Rocketry: The Last Frontier" distributed by Modern Talking Picture Service.	Are students responding and communicating with enthusiasm? Are students using an expanded aerospace vocabulary?
1-1 thru 1-5	1-B. Reading & following directions	Remove instruction sheets from kits & distribute to students. Invite students to read/scan the instructions.	Are students able to read & comprehend the instructions? Can they locate information within the instructions?
		Distribute kits. Invite students to check parts against parts list.	Are students able to correlate written/diagramed information to the concrete materials?
1-6 thru 1-11	1-C. Construction	Make construction materials available, i.e., glue and sandpaper. Invite students to begin construction starting with step #1 & following the construction sequence	Are students using the materials properly? Are students following the instructions in sequence?
	1-D. Painting/decorating (Optional)	Make finishing materials available, i.e., paint & decals. Invite students to decorate their model rocket.	Are students following instructions? Are students expressing creativity & individually?
1-12	1-E. Display	Display model rockets so peers may view the product. (Media coverage may be possible.)	Are students proud of their accomplishments?
II. Launch 2-0	2-A. Motivation	(See Sequence 1-A.) Have launch system on display.	
2-1 thru 2-6	2-B. Launch Procedure	Demonstrate proper launch procedure. Discuss countdown procedure.	Can students replicate the launch & countdown procedures?

Proficiency Code	Sequence	Instructional Activities	Evaluation
2-7	2-C. Safety	Distribute copies of the NAR/HIA Model Rocketry Safety Code. Read aloud or have students read & discuss.	Can students rationalize the need for safety rules & codes?
		Discuss local rules which may be necessary.	
2-1 thru 2-8	2-D. Recovery Procedure	Display a drawing or map of the launch/recovery area. Explain procedures at each point.	Can students explain the procedures & duties at each point in the launch/ recovery area?
		Discuss procedure for tracking the model rocket.	
		Discuss and/or demonstrate best system for recovering a model rocket.	
2-1 thru 2-8	2-E. Engine Preparation	Describe the parts & function of parts of the engine.	Can students identify the parts & function of parts of the engine?
		Demonstrate the function of the igniter. Demonstrate the placement of igniter in engine.	Can students identify the parts & function of parts of the igniter?
		Allow students to arm engines. Stress safety!	Can students successfully arm an engine?
2-1 thru 2-8	2-F. Preping the Model Rocket	Demonstrate placing the recovery wadding, folding & inserting the parachute/streamer, & inserting the armed engine. Invite students to prepare their model rockets.	Do the students follow the prescribed procedure?
	2-G. Review launch, recovery, & safety procedures.		

Proficiency Code	Sequence	Instructional Activities	Evaluation
2-1 thru 2-14	2-H. Launch	Tour the launch area & correlate the important areas to the map used in the classroom (Sequence 2-D). Inspect engines, igniters, nose cones, shock cords, & fins. Determine launch order. Place teams at proper locations. Demonstrate & test launch a model rocket (which is expendable) to check wind & drift. Refold parachutes/streamers. Adjust launch platform.	Can the students identify important locations in the launch area & relate special instructions for each location?
		Begin the launch. Again, check each model rocket before placing it on the launch platform.	Can students follow prescribed procedure?
		Assemble all teams & post-lab the first set of launches. Rotate teams & repeat procedure beginning with a test/demonstration launch.	Do students contribute to post-lab?
		Clean the area. Remove all expended engines & waste materials.	Do students readily cooperate in clean-up activity?
		Return to classroom or assemble in launch area for final post-lab discussion.	Do students contribute to discussion?
Teacher: Clean launch platform so it will not corrode & will be ready for next launch. Wax the launch rod & blast plate deflector plate or spray them with silicone lubricant.			
III. Experimentation 3-1 thru 3-31	3-A. Identification of Problem	Invite students to identify a problem they wish to investigate. Request a written summary of the problem to be investigated.	Are students able to identify & define a problem to study?
	3-B. Search for Related Literature	Require students to provide a written summary of their findings. (Technical Reports & Technical Notes from Estes will be extremely helpful.)	Are students able to search for related data & provide a written summary?

Proficiency Code	Sequence	Instructional Activities	Evaluation
	3-C. Action Research	Invite the student to construct the model rocket & collect or construct other necessary materials. (Discourage the use of materials not necessary in the investigation.)	Is the student able to assemble a "clean" set of materials?
		Invite student to begin research while keeping a log book or other method of recording data.	Is student able to organize the data collection procedure?
	3-D. Summary and Conclusions	Invite student to prepare a report of his/her investigation. (Outstanding studies may be submitted to Estes or the NAR for publication. The Estes Aerospace Club requires a documented experiment to qualify for Skill Level Four.)	Can student draw conclusions, make applications, and prepare a summary statement?

APPENDIX A

TITLE: Safety with Model Rocketry	ACTIVITY NO:

CONCEPT(S): Certain safety rules must be observed to protect the person who is launching, spectators, and private property.

OBJECTIVE(S): At the end of this activity the student should be able to:

1. Recall the safety rules for model rocketry.
2. Create a display which will reinforce those rules.

PROCESS SKILLS: Observation
Communication

SUBJECT AREA:	TIME INVOLVED:	LEVEL:
Science Language Arts Art Math	1-2 50 minute periods	Upper Elementary/ Middle School

MATERIALS NEEDED: Copies of the NAR Model Rocketry Safety Code
Poster board (construction paper)
Markers, crayons, or paint

PROCEDURE:

1. Distribute copies of the safety code. Read and discuss as a large group.
2. Invite students to add rules which are needed locally (house rules).
3. Invite students to choose one rule and design a poster that illustrates that rule.
4. Invite students to write a short paragraph on why the rule they chose is important.
5. Display the posters and reports.

NOTE: Estes or the National Association of Model Rocketry may be able to use some of these materials in their publications.

TITLE: Basic Construction and Launch

ACTIVITY NO:

CONCEPT(S): Systems may be synthesized by assembling a number of sub-systems.

OBJECTIVE(S): At the end of this activity the student should be able to:

1. Build and safely launch a model rocket.

PROCESS SKILLS:
Observation
Classification
Communication

SUBJECT AREA:
Science
Math
Reading

TIME INVOLVED:
3-4 50 min. periods

LEVEL:
Upper Elementary/
Middle School

MATERIALS NEEDED:
Model rocket kits
Construction materials
Launch pads
Engines

PROCEDURE:

1. Remove instruction sheets from kits. Put the rest of the kit away. Discuss with students the parts list and the instructions. Inform the students that when they can read the instructions you will allow them to start construction.
2. Second Period: Complete construction and filleting. Issue safety and launch instructions. Again, inform the students that they cannot proceed until they can read and understand the written materials.
3. Third Period: Decorate the model rockets. Check for faulty construction and make any necessary repairs. Discuss the duties of the safety officer, launch control officer, and recovery team. Make appointments. Review launch and safety instructions.
4. Fourth Period: Launch and recover. Return to classroom and discuss the observations of the launch and recovery. Invite students to suggest ways to make the next launch better. Review the duties and how they were met.

TITLE: Electrical Systems	ACTIVITY NO:

CONCEPT(S): Energy may be transferred and made to do work.

OBJECTIVE(S): At the end of this activity the student should be able to:

1. Explain an electrical circuit.
2. Show application of the electrical circuit concept to the model rocket electrical ignition system.

PROCESS SKILLS: Observation
Communication
Making inferences

SUBJECT AREA: Science	TIME INVOLVED: 1 50 minute period	LEVEL: Upper Elementary/ Middle School

MATERIALS NEEDED: Dry cells, bulbs, and wire (6 inches)
Launch pad and igniters

PROCEDURE:

1. Distribute one dry cell, one bulb, and one piece of wire to each student. Invite them to light the bulb.
2. Assist those who have trouble.
3. Discuss the path the energy followed (circuit).
4. Demonstrate the igniter and launch pad. Place the igniter in front of a dark background and attach it to the launch pad. Follow countdown procedure and power the igniter.
5. Invite the students to make inferences about the similarity of their simple circuit and the launch pad/ignition system.
6. Trace the circuitry of the launch pad. Use sketches with electronic symbols if students are capable of understanding.

TITLE: Recovery Systems	ACTIVITY NO:

CONCEPT(S): The "drag" caused by various recovery systems will affect the time and condition of recovery.

OBJECTIVE(S): At the end of this activity the student should be able to:

1. Describe the best recovery system for his model rocket.

PROCESS SKILLS: Measuring (time)
Collection of data
Control of variables
Formulation of hypotheses

SUBJECT AREA:	TIME INVOLVED:	LEVEL:
Science Math	1x50 minute launch 1x30 minute discussion	Upper Elementary/ Middle School

MATERIALS NEEDED: Stop watch
Various size parachutes and streamers
Model rockets (at least two identical rockets should be prepped)
Launch system and engines

PROCEDURE:

1. Review launch and safety instructions. Assign jobs (responsibilities).
2. Launch rocket without recovery system. Time from tracking smoke to impact. (Care must be exercised because this rocket will impact quite hard and will probably be damaged. This rocket could also injure persons because of the speed of descent if it is not launched over a large recovery area with no recovery team.)
3. Use rocket with recovery system recommended by manufacturer. Record time from tracking smoke to touchdown.
4. Use an alternate recovery system. Launch and record time as before.
5. Place data on a graph. Use type of recovery system as horizontal axis and time of recovery for vertical axis.
6. Invite the students to make inferences about the effect of various recovery systems and the safety involved.

TITLE: Payloading	ACTIVITY NO:

CONCEPT(S): The effect of and on payloads in model rockets may be predicted.

OBJECTIVE(S): At the end of this activity the student should be able to:

1. Predict with some accuracy the effect of a payload on the flight of a model rocket.

PROCESS SKILLS: Data collection
Control of variables
Formulate hypotheses

SUBJECT AREA:	TIME INVOLVED:	LEVEL:
Science Math	2 50 minute periods	Upper Elementary/ Middle School

MATERIALS NEEDED: Rocket such as X-Ray or Marauder. The Alpha may be modified for this activity.
Launch pad and engines
Stop watch and AltiTrak (Estes trade name)

PROCEDURE:

1. Review safety and launch procedures. Assign officers and recovery teams.
2. Launch. Record time from launch to apogee and altitude at apogee.
3. Add payload and launch again. Record data as before. (Do not exceed the payload recommended by the manufacturer.)
4. Increase or decrease payload. Launch and record as before.
5. Return to classroom and graph data. Use weight of payload as horizontal axis and altitude as vertical axis. Use second indicator to record time as vertical axis. Analyze the data/graphs and make inferences/hypotheses about other payloads, other rockets, or other engines. Is there any correlation between altitude and time? Change the indices and regraph to look for correlation between other variables.

TITLE: Kentucky Windage (Angle of Launch)	ACTIVITY NO:

CONCEPT(S): The angle at which the rocket is launched affects the flight and location of touchdown.

OBJECTIVE(S): At the end of this activity the student should be able to:

1. Describe the effect that changing of the angle of launch has on the rocket's path.

PROCESS SKILLS: Data collection and graphing
Control of variables
Formulating hypotheses

SUBJECT AREA:	TIME INVOLVED:	LEVEL:
Science Math	1 period in field 1 period in classroom	Upper Elementary/ Middle School

MATERIALS NEEDED: Rockets and engines
Launch pads
Carpenter's level and protractor (or plumb line and protractor)
Measuring tapes (100 ft. if possible)

PROCEDURE:

1. Review launch preparation and safety. Establish safety officer, launch officer, and recovery team.
2. Instruct on how to use level and protractor to measure angle of launch rod. Students may need practice before going to the launch area.
3. Launch on a calm day. Keeping as many variables constant as possible, launch rockets with launch rod at angles from the vertical of 0°, 10°, and 20°. (Never allow a launch from a pad with the launch rod adjusted to more than 30° from the vertical.) Measure and record the distance from the pad to the touchdown and the angle of the launch rod for each launch.
4. Return to the classroom and convert the data to graphs using angle as one index and distance as the other. Invite students to analyze the graphs and infer the results of changing variables such as weight of rocket, size of engine, wind speed and direction, type of recovery system, etc.

TITLE: Computers and Model Rockets	ACTIVITY NO:

CONCEPT(S): Applications of computer produced data can assist in predicting the performance of model rockets.

OBJECTIVE(S): At the end of this activity the student should be able to:

1. Apply computer produced data to predict the flight of a model rocket.

PROCESS SKILLS: Collection of data
Formulation of hypotheses

SUBJECT AREA:	TIME INVOLVED:	LEVEL:
Computer Science Physics	Varies	Upper Elementary/ Middle School

MATERIALS NEEDED: Computer program (available from Estes or NAR)
Model rocket and "specs" (specifications) on the rocket
Launch system
Stop watch and AltiTrak

PROCEDURE:

1. Utilize the computer program to predict rocket performance.
2. Launch the rocket and record data.
3. Compare actual data to predicted data. Some variation will occur. What variables might cause this variation?

TITLE: Identifying Variables

ACTIVITY NO:

CONCEPT(S): A number of variables over which the launch team has no control will effect the performance of the rocket.

OBJECTIVE(S): At the end of this activity the student should be able to:

1. Identify variables which may affect the flight and recovery of the rocket.

PROCESS SKILLS: Observation
Communication
Inferences
Control of variables

SUBJECT AREA: Science
Math

TIME INVOLVED: 1 period

LEVEL: Upper Elementary/ Middle School

MATERIALS NEEDED: One rocket
Launch system
Two engines, same type
Markers for touchdown points

NOTE: Have a back-up rocket & extra engines ready.

PROCEDURE:

1. Inform students of the object of this activity. Invite them to observe the launch team and recovery team as well as the flight and landing of the rocket.
2. Instruct recovery teams to let rocket touchdown and to mark the touchdown point.
3. Proceed to the launch area. Prep and launch rocket.
4. Repeat prep and launch keeping as many variables as possible constant.
5. Invite students to offer inferences as to why the rocket did not land in exactly the same spot. List the inferences.
6. Reinforce the importance of controlling variables in scientific experiments.

APPENDIX B

NAR/HIA MODEL ROCKETRY SAFETY CODE

1. Construction - My model rockets will be made of lightweight materials such as paper, wood, plastic and rubber, without any metal as structural parts.

2. Engines - I will use only pre-loaded factory-made NAR safety-certified model rocket engines in the manner recommended by the manufacturer. I will not change in any way nor attempt to reload these engines.

3. Recovery - I will always use a recovery system in my rockets that will return them safely to the ground so that they may be flown again.

4. Weight Limits - My model rocket will weigh no more than 453 grams (16 oz.) at lift-off and the engine will contain no more than 113 grams (4 oz.) of propellant.

5. Stability - I will check the stability of my model rockets before their first flight, except when launching models of already proven stability.

6. Launching System - The system I use to launch my model rockets must be remotely controlled and electrically operated and will contain a switch that will return to "off" when released. I will remain at least 15 feet from any rocket that is being launched.

7. Launch Safety - I will not let anyone approach a model rocket on a launcher until I have made sure that either the safety interlock key has been removed or the battery has been disconnected from my launcher.

8. Flying Conditions - I will not launch my model rockets in high winds, near buildings, power lines, tall trees, low flying aircraft, or under any conditions which might be dangerous to people or property.

9. Launch Area - My model rockets will always be launched from a cleared area, free of any easy to burn materials, and I will only use flame resistant recovery wadding in my rockets.

10. Jet Deflector - My launcher will have a jet deflector device to prevent the engine exhaust from hitting the ground directly.

11. Launch Rod - To prevent accidential eye injury I will always place the launcher so the end of the rod is above eye level or cap the end of the rod with my hand when approaching it. I will never place my head or body over the launching rod. When my launcher is not in use I will always store it so that the launch rod is not in an upright position.

12. Power Lines - I will never attempt to recover my rocket from power lines or other dangerous places.

13. Launch Targets & Angle - I will not launch rockets so their flight path will carry them against targets on the ground, and will never use an explosive warhead nor a payload that is intended to be flammable. My launching device will always be pointed within 30 degrees of vertical.

14. Pre-Launch Test - When conducting research activities with unproven designs or methods, I will, when possible, determine their reliability through pre-launch tests. I will conduct launchings of unproven designs in complete isolation from persons not participating in the actual launching.

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NAR/HIA
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